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Population Dynamics of Mourning Doves Banded in Missouri

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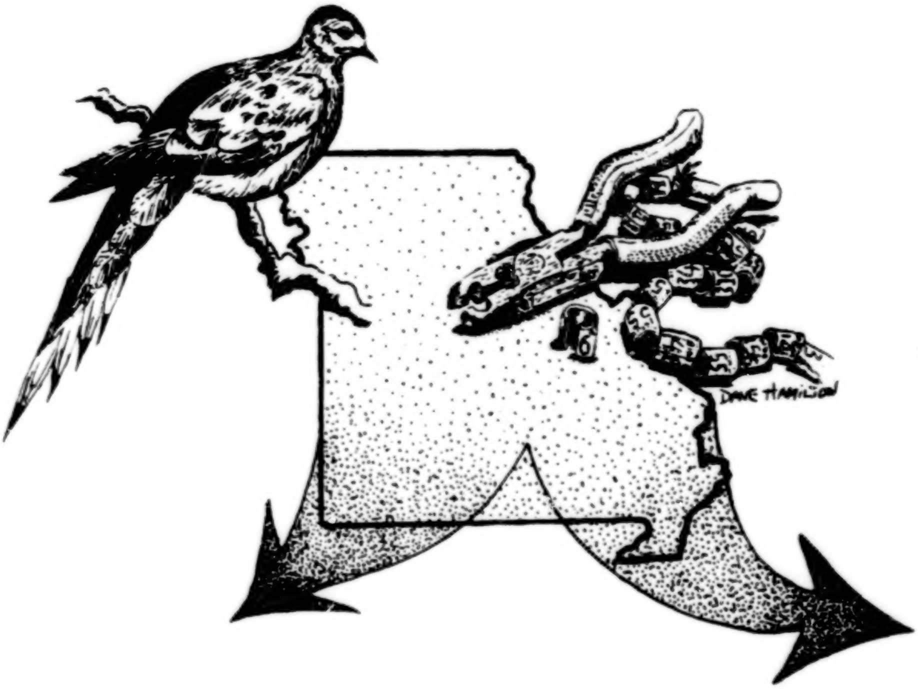

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POPULATION DYNAMICS OF MOURNING DOVES BANDED IN MISSOURI

By Richard D. Atkinson
Thomas S. Baskett
Kenneth C. Sadler

UNITED STATES DEPARTMENT OF THE INTERIOR
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I

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Population Dynamics of Mourning Doves Banded in Missouri[1]

by

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Abstract

Most mourning doves (*Zenaida macroura*) banded in eastern Missouri in 1968–76 and recovered outside the State moved south-southeast into Kentucky, Tennessee, Mississippi, Alabama, Georgia, Florida, and South Carolina. Most doves banded in central and western Missouri and recovered elsewhere moved south-southwest into Kansas, Oklahoma, Louisiana, Texas, Mexico, and Central America. Several central Missouri doves moved southeast.

About three-fourths of the 653 direct recoveries of mourning doves banded in Missouri during 1968–76 were made in Missouri. Adults banded in Missouri were recovered in Missouri in significantly higher ($P < 0.05$) proportions (86%) than immatures (68%), and a significantly ($P < 0.05$) higher proportion of adult males (93%) than adult females (73%) was recovered in the State.

Less than 7% of the Missouri harvest of banded doves consisted of doves from other States, primarily from States bordering Missouri on the east.

The average direct recovery rate for doves of all ages was 3.02%. Recovery rates varied by age, sex, and year of banding. Immatures had a significantly higher ($P < 0.05$) direct recovery rate (3.30%) than adults (2.47%). The direct recovery rate for adult males was 2.56%, and for females, 2.33%.

The overall survival rate of Missouri male doves (46.7%) differed significantly ($P < 0.05$) from that of adult females (31.2%) banded in 1968–76. The combined survival rate for adults (42.4%) and immatures (25.1%) differed significantly ($P < 0.05$).

Hunting accounted for about 19% of immature mortality and 18% of adult mortality. Twenty percent of adult male mortality and 14% of adult female mortality was due to hunting.

The mourning dove (*Zenaida macroura*) is the most widely hunted bird in the United States. More mourning doves are harvested each year than all other migratory game birds combined; the estimated annual harvest exceeds 49 million birds (Keeler 1977).

Management of the species is mainly through hunting regulations. Season opening dates, season length, bag limits, and shooting hours have been adjusted in an attempt to alter numbers of doves harvested. Different manipulations are possible in each of three management units (Fig. 1), which are based on migratory pathways.

The mourning dove breeding range extends from the southern portion of the Canadian provinces through the United States, the Greater Antilles, and Mexico (Keeler 1977). Because the mourning dove range transcends national boundaries, management must be international in scope. Departure dates, destination of migratory doves, survival rates, and homing tendencies are important aspects of mourning dove biology that must be considered in management decisions.

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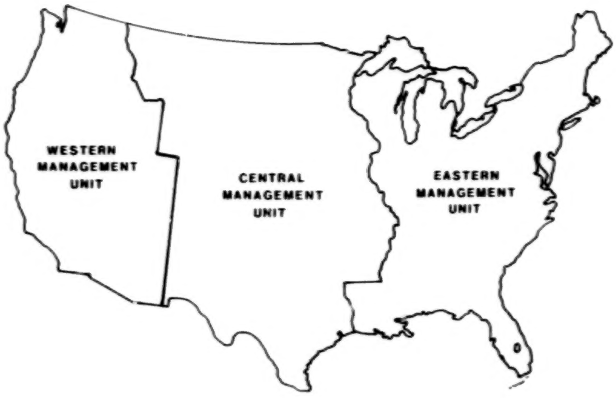

Fig. 1. Mourning dove management units, after Kiel (1959).

Analysis of banding data is an important accepted method of determining aspects of the population dynamics and related biology of the mourning dove. To provide such data, the Missouri Department of Conservation initiated a summer dove banding program in north-central Missouri in 1953. Resulting data, 1953–67, were analyzed and reported by Wight (1954), Tomlinson et al. (1960), and Henry (1970). During the late 1960's the program was expanded to include southeastern and southwestern Missouri. The present paper reports on data gathered from 1968 through 1976; additional details are available in Atkinson (1978).

Specific objectives of the study were as follows: (1) to investigate geographical and chronological dispersal of Missouri-produced doves, (2) to estimate mortality rates by age and sex groups, (3) to determine production needed to maintain a stable population with existing mortality rates, and (4) to determine to what extent doves produced in other States contribute to the total harvest in Missouri.

Materials and Methods

Banding and Recovery Data

The banding and recovery data analyzed in this study were made available by the Bird Banding Laboratory, Office of Migratory Bird Management, U.S. Fish and Wildlife Service, Laurel, Maryland. Only adult mourning doves of known sex, and immature mourning doves banded in May–August, were used in this analysis. Mourning doves banded in Missouri during this period were considered to be Missouri-produced doves; those banded earlier may have been transients migrating through the State. Only recoveries reported as "shot" from September through February 1968–75 and September–December 1976 were considered in this paper.

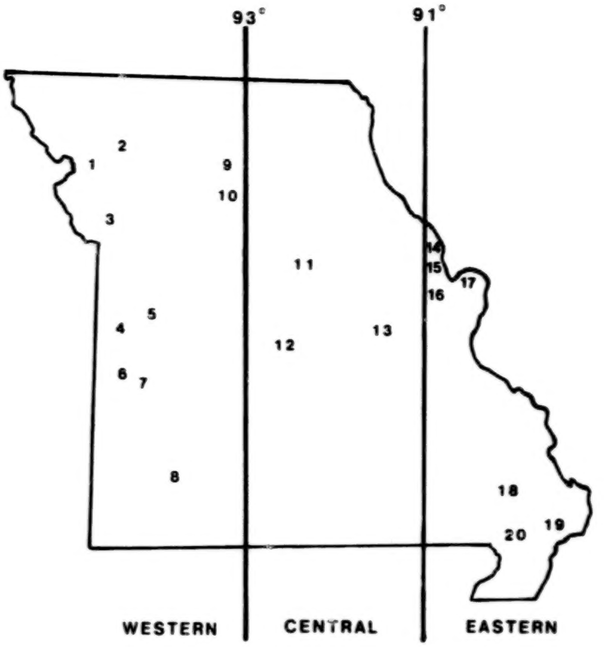

Fig. 2. Locations of 20 dove banding sites within three Missouri banding regions. Key: 1. St. Joseph; 2. Pony Express Wildlife Area, Dekalb County; 3. Trimble Wildlife Area, Clinton County; 4. Butler; 5. Montrose Wildlife Area, Henry County; 6. Rich Hill; 7. Schell-Osage Wildlife Area, Vernon County; 8. Mt. Vernon; 9. Fountain Grove Wildlife Area, Linn County; 10. Swan Lake National Wildlife Refuge, Chariton County; 11. Charles W. Green Wildlife Area and Bradford Farm, Boone County; 12. Versailles; 13. Freedom; 14. Upper Mississippi Wildlife Area, Lincoln County; 15. Elsberry; 16. Weldon Springs; 17. Portage Des Sioux; 18. Duck Creek Wildlife Area, Stoddard County; 19. Sikeston; and 20. Malden.

For analysis, Missouri was divided into three regions: eastern Missouri, east of 91° west longitude; central Missouri, between 91 and 93° west longitude; and western Missouri, west of 93° west longitude (Fig. 2).

Breeding Density Index (BDI)

As part of a national Call-count Survey (Dolton 1977), counts were conducted on 20 routes in Missouri each year of the study period. Five routes were in the eastern region, eight in the central region, and seven in the western region. Call-count Survey procedures and Breeding Density Index data for each State having recoveries in Missouri were derived from the 1976 Mourning Dove Status Report (Dolton 1977).

Land Area Index (LAI)

The Land Area Index for Missouri and for each State providing a recovery in Missouri was obtained from Dolton (1977).

Weighting Procedure

Kiel's (1959) weighting procedure was used to compensate for differences in banding effort, land area, and breeding density:

$$\text{Weight per recovery} = \frac{\text{BDI} \times \text{LAI}}{\text{Number of doves banded}}$$

The weight per recovery for each age and sex group of doves was computed for doves banded in Missouri and recovered in Missouri, and for doves banded in other States and recovered in Missouri. The numbers of doves banded in each State during the study period were obtained from the Bird Banding Laboratory, Office of Migratory Bird Management, Laurel, Maryland.

Survival Rates

Survival rates were estimated according to the method of Brownie et al. (1978). Even though a difference in survival rates of adult males and adult females was detected, the data for adults were combined so an adult–immature survival rate comparison could be made. The program ESTIMATE was used to estimate survival rates for adult males and females. Program BROWNIE was used to estimate survival rates for immature mourning doves.

Mortality Attributable to Hunting

The method used to evaluate the influence of hunting on mortality rates was based on Geis (1972) as modified by Dunks (1977). In this method, recovery rates were adjusted upward to compensate for banded doves shot but not reported. Tomlinson (1968) estimated the band reporting rate, based on a reward-band study, in Missouri, at 32%. Harvest rate was determined as follows:

$$\text{Harvest rate} = \frac{\text{recovery rate}}{\text{reporting rate}}$$

Dunks (1977) adjusted the harvest rate to compensate for doves shot but not retrieved by the formula

$$\text{Kill rate} = \frac{\text{harvest rate}}{1 - \text{crippling rate}}$$

A 26% crippling loss was estimated for bag samples taken in several southern States from 1949 to 1955 (Southeastern Association of Game and Fish Commissioners 1957). The kill rate/mortality rate = portion of mortality due to hunting.

Productivity Needed to Maintain a Stable Population

The productivity required to maintain a stable population was estimated by dividing the annual adult mortality rate by the corresponding immature survival rate (Orr 1973).

Statistical Test

Throughout the paper 2 × 2 contingency tables were analyzed by chi square to determine significance at $P = 0.05$.

Results

Geographic Dispersal of Missouri-banded Doves

From 1968 to 1976, 21,624 mourning doves (4,537 males, 2,790 females, and 14,297 immatures) were banded at 20 sites in Missouri (Fig. 2) during May–August. Of the 933 recovered bands, 888 were reported as "shot."

To determine the dispersal of mourning doves from Missouri in the fall, direct recovery locations were plotted within the 1° area of recovery (Appendix Figs. A-1 through A-3). Direct recoveries of doves banded in Missouri but recovered elsewhere were by no means confined to the Central Management Unit (Fig. 1). They were distributed as follows: Eastern Management Unit, 79 (50%); Central Unit, 55 (35%); Western Unit, 1 (<1%); Mexico and Central America, 23 (15%). Doves from all banding regions in Missouri moved southward from Missouri. The general movement of doves banded in central and western Missouri was south-southwest across Kansas and Oklahoma into Texas; a portion of the central and western Missouri doves moved into Louisiana, whereas others traveled into Mexico and Central America. A segment of the western Missouri population moved westward as evidenced by one direct and one indirect recovery reported in California. The general movement of doves banded in eastern Missouri was south-southeast into Illinois, Kentucky, Tennessee, Mississippi, Alabama, Florida, Georgia, and South Carolina. Several central Missouri birds also followed this southeastern pathway.

The distributions of direct recoveries of adult male, adult female, immature, and all ages of mourning doves are presented in Tables 1 and 2. The major recovery region for Missouri-banded doves was the State of Missouri, where over 75% of the recoveries occurred. The proportion of recoveries in Missouri of adult doves (86%) was significantly higher than that of immatures (72%). The proportion of adult male recoveries occurring in Missouri was significantly higher than the proportion of adult female recoveries in Missouri (93 and 72%, respectively).

Most recoveries were made in the Missouri region of banding. The proportion of recoveries occurring in the region of banding was higher for adult than immature doves (Table 1) and for adult male than adult female doves (Table 2). More than 94% of the direct recoveries of adult doves banded in central Missouri were recovered in Missouri. Eighty-six percent of eastern Missouri adult recoveries

Table 1. *Geographic distribution of direct recoveries of adult and immature mourning doves banded in Missouri in 1968–76 and recovered through 1976; percentages in italics.*[a]

Area of recovery	Adults				Immatures				Adults plus immatures
	Missouri region of banding				Missouri region of banding				
	Eastern	Central	Western	Total	Eastern	Central	Western	Total	
Missouri									
Eastern	70 *84.3*	— —	— —	70 *38.7*	171 *73.1*	— —	— —	171 *36.2*	241 *36.9*
Central	1 *1.2*	47 *92.2*	1 *2.1*	49 *27.1*	6 *2.6*	122 *71.4*	— —	128 *27.1*	177 *27.1*
Western	— —	1 *2.0*	35 *74.5*	36 *19.9*	— —	8 *4.7*	33 *49.3*	41 *8.7*	77 *11.8*
Total	71 *85.5*	48 *94.2*	36 *76.6*	155 *85.6*	177 *75.7*	130 *76.1*	33 *49.3*	340 *72.0*	495 *75.8*
Alabama	2 *2.4*	— —	— —	2 *1.1*	2 *0.9*	2 *1.2*	— —	4 *0.9*	6 *0.9*
Arkansas	2 *2.4*	— —	— —	2 *1.1*	2 *0.9*	— —	— —	2 *0.4*	4 *0.6*
California	— —	— —	— —	— —	— —	— —	1 *1.5*	1 *0.2*	1 *0.2*
El Salvador	— —	— —	— —	— —	— —	— —	1 *1.5*	1 *0.2*	1 *0.2*
Florida	— —	1 *2.0*	— —	1 *0.6*	11 *4.7*	7 *4.1*	1 *1.5*	19 *4.0*	20 *3.1*
Georgia	2 *2.4*	— —	— —	2 *1.1*	6 *2.6*	— —	— —	6 *1.3*	8 *1.2*
Guatemala	1 *1.2*	— —	2 *4.3*	3 *1.7*	— —	— —	1 *1.5*	1 *0.2*	4 *0.6*
Illinois	1 *1.2*	— —	— —	1 *0.6*	16 *6.8*	1 *0.6*	— —	17 *3.6*	18 *2.8*
Kansas	1 *1.2*	— —	1 *2.1*	2 *1.1*	1 *0.4*	4 *2.3*	6 *9.0*	11 *2.3*	13 *2.0*
Kentucky	— —	— —	— —	— —	2 *0.9*	— —	— —	2 *0.4*	2 *0.3*
Louisiana	— —	— —	1 *2.1*	1 *0.6*	7 *3.0*	2 *1.2*	4 *6.0*	13 *2.8*	14 *2.1*
Mexico	— —	— —	2 *4.3*	2 *1.1*	2 *0.9*	7 *4.1*	7 *10.5*	16 *3.4*	18 *2.8*
Mississippi	1 *1.2*	— —	— —	1 *0.6*	— —	2 *1.2*	1 *1.5*	3 *0.6*	4 *0.6*
Oklahoma	— —	1 *2.0*	1 *2.1*	2 *1.1*	1 *0.4*	3 *1.8*	1 *1.5*	5 *1.1*	7 *1.1*
South Carolina	— —	— —	— —	— —	3 *1.3*	1 *0.6*	1 *1.5*	5 *1.1*	5 *0.8*
Tennessee	1 *1.2*	— —	— —	1 *0.6*	1 *0.4*	— —	— —	1 *0.2*	2 *0.3*
Texas	1 *1.2*	1 *2.0*	4 *8.5*	6 *3.3*	3 *1.3*	12 *7.0*	10 *15.0*	25 *5.3*	31 *4.7*
Total	83	51	47	181	234	171	67	472	653

[a]For detailed locations of recoveries occurring outside Missouri, see Appendix Figs. A1–A3

Table 2. *Geographic distribution of direct recoveries of adult male and female mourning doves banded in Missouri in 1968–76 and recovered through 1976; percentages in italics.*

Area of recovery	Males				Females			
	Missouri region of banding				Missouri region of banding			
	Eastern	Central	Western	Total	Eastern	Central	Western	Total
Missouri								
Eastern	49 *94.2*	— —	— —	49 *42.2*	21 *67.7*	— —	— —	21 *32.3*
Central	— —	33 *97.1*	— —	33 *28.5*	1 *3.2*	14 *82.4*	1 *5.9*	16 *24.6*
Western	— —	1 *2.9*	25 *83.3*	26 *22.4*	— —	— —	10 *58.8*	10 *15.4*
Total	49 *94.2*	34 *100.0*	25 *83.3*	108 *93.1*	22 *70.9*	14 *82.4*	11 *64.7*	47 *72.3*
Alabama	— —	— —	— —	— —	2 *6.5*	— —	— —	2 *3.1*
Arkansas	— —	— —	— —	— —	2 *6.5*	— —	— —	2 *3.1*
Florida	— —	— —	— —	— —	— —	1 *5.9*	— —	1 *1.5*
Georgia	1 *1.9*	— —	— —	1 *0.9*	1 *3.2*	— —	— —	1 *1.5*
Guatemala	— —	— —	— —	— —	1 *3.2*	— —	2 *11.8*	3 *4.6*
Illinois	— —	— —	— —	— —	1 *3.2*	— —	— —	1 *1.5*
Kansas	1 *1.9*	— —	— —	1 *0.9*	— —	— —	1 *5.9*	1 *1.5*
Louisiana	— —	— —	— —	— —	— —	— —	1 *5.9*	1 *1.5*
Mexico	— —	— —	2 *6.7*	2 *1.7*	— —	— —	— —	— —
Mississippi	— —	— —	— —	— —	1 *3.2*	— —	— —	1 *1.5*
Oklahoma	— —	— —	1 *3.3*	1 *0.9*	— —	1 *5.9*	— —	1 *1.5*
Tennessee	— —	— —	— —	— —	1 *3.2*	— —	— —	1 *1.5*
Texas	1 *1.9*	— —	2 *6.7*	3 *2.6*	— —	1 *5.9*	2 *11.8*	3 *4.6*
Total	52	34	30	116	31	17	17	65

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Table 3. *Geographic distribution (%) of indirect recoveries of mourning doves banded in Missouri, 1968–75, and recovered through 1976.*[a]

Recovery location	Adults			Immatures
	Males	Females	Total	
Missouri				
Eastern	39.0	34.8	38.1	32.3
Central	22.0	26.1	22.9	26.9
Western	20.7	13.0	19.0	10.8
Total	81.7	73.9	80.0	70.0
Alabama	–	–	–	1.5
Arkansas	–	4.3	1.0	1.5
California	–	–	–	0.8
El Salvador	–	4.3	1.0	–
Florida	–	–	–	0.8
Georgia	–	–	–	2.3
Illinois	2.4	–	1.9	5.4
Kansas	1.2	–	1.0	0.8
Kentucky	–	–	–	0.8
Louisiana	–	4.3	1.0	2.3
Mexico	3.7	4.3	3.8	2.3
Mississippi	–	–	–	1.5
North Carolina	–	–	–	0.8
Oklahoma	1.2	4.3	1.9	–
Texas	9.8	4.3	8.6	9.2

[a]For breakdown of indirect recoveries by Missouri region of banding, see Appendix Table B-1; for detailed locations of recoveries occurring outside Missouri, see Appendix Fig. A-4.

and 77% of western Missouri adult recoveries were in Missouri. Central and eastern Missouri had the highest percentage of direct recoveries of immature doves in Missouri (76% each), whereas western Missouri had 49% of immature direct recoveries occurring in Missouri.

Indirect recoveries of adult and immature mourning doves banded in Missouri are presented in Table 3. The distribution pattern of indirect recoveries was generally similar to that of direct recoveries. The highest proportion of indirect recoveries occurred in Missouri, and as with direct recoveries, Texas accounted for the highest number of out-of-state recoveries. However, a smaller proportion of indirect than direct recoveries was made in the Eastern Management Unit.

Chronology of the Harvest of Missouri-banded Doves

Only recoveries with complete information were included in this analysis; thus, numbers of recoveries are not always identical with those used previously in the text. The chronology of the harvest of direct recoveries of mourning doves banded in Missouri is presented in Tables 4–6. Most of the harvest of mourning doves banded in Missouri occurred during September. About 84% of direct recoveries of adult doves and 80% of direct recoveries of immatures were made during that month (Tables 4 and 5). For both adult and immature doves, over 59% of the harvest occurred during

Table 4. *Chronology of direct recoveries (%) of adult mourning doves banded in Missouri in 1968–76 and recovered through 1976.*[a]

Recovery location	Total recoveries	Date of recovery								
		September								
		1–10	11–20	21–30	Total	Oct.	Nov.	Dec.	Jan.	Feb.
Missouri										
Eastern	67	70.2	11.9	4.5	86.6	13.4	–	–	–	–
Central	44	61.4	27.3	6.8	95.5	4.6	–	–	–	–
Western	36	72.2	22.2	2.8	97.2	2.7	–	–	–	–
Total	147									
Alabama	2	–	–	–	–	–	50.0	50.0	–	–
Arkansas	2	–	100.0	–	100.0	–	–	–	–	–
Florida	1	–	–	–	–	–	–	–	100.0	–
Georgia	2	–	–	50.0	50.0	–	–	–	50.0	–
Guatemala	3	–	–	–	–	33.3	–	33.3	33.3	–
Illinois	1	–	–	100.0	100.0	–	–	–	–	–
Kansas	2	100.0	–	–	100.0	–	–	–	–	–
Louisiana	1	–	–	–	–	100.0	–	–	–	–
Mexico	2	–	–	–	–	50.0	–	–	–	50.0
Mississippi	1	–	–	–	–	–	100.0	–	–	–
Oklahoma	2	–	–	–	–	100.0	–	–	–	–
Tennessee	1	–	–	–	–	100.0	–	–	–	–
Texas	6	–	75.0	25.0	100.0	–	–	–	–	–
Total	173	59.3	19.2	5.8	84.3	11.0	1.2	1.2	1.7	0.6

[a]Detailed numerical bases for these percentages are in Appendix Table B-2.

Table 5. *Chronology of direct recoveries (%) of immature mourning doves banded in Missouri in 1968–76, and recovered in 1968–76.*[a]

		Date of recovery								
		September								
Recovery location	Total recoveries	1–10	11–20	21–30	Total	Oct.	Nov.	Dec.	Jan.	Feb.
Missouri										
Eastern	166	69.9	19.9	3.6	93.4	6.6	–	–	–	–
Central	120	76.7	11.7	6.7	95.1	5.0	–	–	–	–
Western	33	84.9	15.2	–	100.0	–	–	–	–	–
Total	319									
Alabama	4	–	–	50.0	50.0	25.0	25.0	–	–	–
Arkansas	2	50.0	50.0	–	100.0	–	–	–	–	–
California	1	100.0	–	–	100.0	–	–	–	–	–
El Salvador	1	–	–	–	–	–	–	100.0	–	–
Florida	20	–	–	–	–	60.0	20.0	15.0	5.0	–
Georgia	6	33.3	16.7	–	50.0	16.7	16.7	16.7	–	–
Guatemala	1	–	–	–	–	–	–	100.0	–	–
Illinois	16	68.8	25.0	6.3	100.0	–	–	–	–	–
Kansas	10	50.0	40.0	–	90.0	10.0	–	–	–	–
Kentucky	2	–	100.0	–	100.0	–	–	–	–	–
Louisiana	12	8.3	–	–	8.3	25.0	25.0	25.0	16.7	–
Mexico	10	–	–	–	–	40.0	30.0	10.0	10.0	10.0
Mississippi	4	–	–	25.0	25.0	–	50.0	–	25.0	–
Oklahoma	5	60.0	20.0	20.0	100.0	–	–	–	–	–
South Carolina	4	–	50.0	–	50.0	25.0	–	25.0	–	–
Tennessee	1	–	–	–	–	100.0	–	–	–	–
Texas	24	8.3	12.5	8.3	29.1	58.3	8.3	–	4.2	–
Total	442	59.3	15.8	4.8	79.9	12.4	3.8	2.3	1.4	0.2

[a]Detailed numerical bases for these percentages are in Appendix Table B-3.

the first 10 days in September. Eighty-eight percent of the adult males were harvested during September, whereas only 77% of the females were harvested then (Table 6).

Western Missouri had the highest percentage of direct recoveries of adult doves in September (97%), central Missouri had 96%, and eastern Missouri, 87% (Table 4). Western Missouri had the highest proportion of adult males recovered in September (100%). Ninety-seven percent of the central Missouri adult male harvest and 82% of the eastern Missouri adult male harvest occurred during September. Eastern Missouri had the highest percentage of female doves harvested in September (95%); central and western Missouri had 92 and 91%, respectively. The distribution of recoveries of immatures followed the same trend as recoveries of adults. Western Missouri had the largest percentage of recoveries occurring in September (100%); central and eastern Missouri had 95 and 93%, respectively.

The pattern of out-of-state recoveries for adult and immature doves was similar. Most recoveries occurred in September and the number of recoveries declined each month through February. The general trend was for the early recoveries to be in the midwestern States (e.g., Kansas, Illinois, Arkansas) and later recoveries to occur farther south (e.g., Alabama, Georgia, Florida), as expected.

States Contributing to the Missouri Dove Harvest

Mourning doves banded in other States and recovered directly in Missouri were from the Eastern and Central Management Units. No direct recoveries of doves banded in the Western Management Unit were reported in Missouri. Most direct recoveries were from States bordering Missouri; Kentucky and Illinois combined contributed half the direct recoveries of doves banded out of Missouri (Table 7). Mississippi, North Dakota, and Wisconsin were the only States not bordering Missouri that had banded doves recovered directly in Missouri. The eastern region of Missouri had the largest number of direct recoveries of doves banded out of State (25); central and western Missouri had 6 and 3 recoveries, respectively.

About 78% of the direct recoveries of adults and 92% of the direct recoveries of immatures banded in other States and recovered in Missouri occurred during September (Table 8). Most recoveries of immatures (56%) banded out of State and recovered in Missouri were during the first 10 days in September; the corresponding figure for adults was only 33%.

Table 6. *Chronology of direct recoveries (%) of adult male and female mourning doves banded in Missouri in 1968–76 and recovered through 1976.*[a]

Sex and recovery location	Total recoveries	Date of recovery								
		September								
		1–10	11–20	21–30	Total	Oct.	Nov.	Dec.	Jan.	Feb.
Males										
Missouri										
Eastern	45	64.4	11.1	6.7	82.2	17.8	–	–	–	–
Central	31	54.8	32.3	9.7	96.8	3.2	–	–	–	–
Western	25	80.0	16.0	4.0	100.0	–	–	–	–	–
Total	101									
Georgia	1	–	–	100.0	100.0	–	–	–	–	–
Kansas	1	100.0	–	–	100.0	–	–	–	–	–
Mexico	2	–	–	–	–	50.0	–	–	–	50.0
Oklahoma	1	–	–	–	–	100.0	–	–	–	–
Texas	3	–	66.6	–	66.6	33.3	–	–	–	–
Total	109	61.5	19.3	7.3	88.1	11.0	–	–	–	0.9
Females										
Missouri										
Eastern	21	81.0	14.3	–	95.3	4.8	–	–	–	–
Central	13	76.9	15.4	–	92.3	7.7	–	–	–	–
Western	11	54.5	36.4	–	90.9	9.1	–	–	–	–
Total	45									
Alabama	2	–	–	–	–	–	50.0	50.0	–	–
Arkansas	1	–	100.0	–	100.0	–	–	–	–	–
Florida	1	–	–	–	–	–	–	–	100.0	–
Georgia	1	–	–	–	–	–	–	–	100.0	–
Guatemala	3	–	–	–	–	33.3	–	33.3	33.3	–
Illinois	1	–	–	100.0	100.0	–	–	–	–	–
Kansas	1	100.0	–	–	100.0	–	–	–	–	–
Louisiana	1	–	–	–	–	100.0	–	–	–	–
Mississippi	1	–	–	–	–	–	100.0	–	–	–
Oklahoma	1	–	–	–	–	100.0	–	–	–	–
Tennessee	1	–	–	–	–	100.0	–	–	–	–
Texas	3	–	66.7	33.3	100.0	–	–	–	–	–
Total	62	54.8	19.4	3.2	77.4	11.3	3.2	3.2	4.8	–

[a] Detailed numerical bases for these percentages are in Appendix Tables B-4 and B-5.

Table 7. *Origins of mourning doves banded in other States in 1968–76 and recovered directly in different harvest regions of Missouri.*

State of origin	Life stage and harvest area in Missouri[a]										
	Adult					Immature					Adult plus immatures, total %
	E	C	W	Total	%	E	C	W	Total	%	
Arkansas	1	–	–	1	11	4	–	–	4	16	15
Illinois	1	1	–	2	22	6	–	–	6	24	23
Iowa	–	1	–	1	11	–	–	–	–	–	3
Kansas	–	–	1	1	11	–	–	–	–	–	3
Kentucky	–	–	–	–	–	9	–	–	9	36	26
Mississippi	–	–	–	–	–	2	–	–	2	8	6
North Dakota	–	2	–	2	22	–	–	–	–	–	6
Wisconsin	1	1	–	2	22	1	1	2	4	16	18
Total	3	5	1	9		22	1	2	25		

[a] E = Eastern, C = Central, W = Western; % = percent of total harvest in Missouri originating in different States.

Table 8. *Chronology of direct recoveries of mourning doves banded in other States in 1968–76 and recovered in Missouri through 1976.*

	Life stage and date of recovery											
	Adults						Immatures					
	September						September					
State of origin	1–10	11–20	21–30	Total	Oct.	Total	1–10	11–20	21–30	Total	Oct.	Total
Arkansas	1	–	–	1	–	1	3	–	1	4	–	4
Illinois	1	1	–	2	–	2	2	2	–	4	2	6
Iowa	–	1	–	1	–	1	–	–	–	–	–	–
Kansas	–	1	–	1	–	1	–	–	–	–	–	–
Kentucky	–	–	–	–	–	–	7	2	–	9	–	9
Mississippi	–	–	–	–	–	–	1	1	–	2	–	2
North Dakota	–	–	1	1	1	2	–	–	–	–	–	–
Wisconsin	1	–	–	1	1	2	1	2	1	4	–	4
Total	3	3	1	7	2	9	14	7	2	23	2	25
Percent[a]	33	33	11	78	22		56	28	8	92	8	

[a]Percent of total for life stage.

Table 9. *State of origin and contribution to harvest of mourning doves (all ages) banded in 1968–76 and recovered in Missouri through 1976, based on weighted direct recoveries.*

State of origin	Weighting factor	Number of direct recoveries	Weighted recoveries	Contribution to harvest (%)
Missouri	0.13	495	63.5	93.4
Arkansas	0.12	5	0.6	0.9
Illinois	0.14	8	1.1	1.6
Iowa	0.10	1	0.1	0.2
Kansas	0.25	1	0.3	0.4
Kentucky	0.15	9	1.4	2.0
Mississippi	0.05	2	0.1	0.2
North Dakota	0.26	2	0.5	0.8
Wisconsin	0.07	6	0.4	0.6
Total			68.0	100.0

Contribution to the Missouri Dove Harvest by Doves Produced out of State

Based on weighted direct recoveries, over 93% of the banded doves harvested in Missouri were banded in Missouri (Table 9; weighting factors are presented in Table B-6). About 95% of the adult and 92% of the immature doves harvested in Missouri were banded in State (Table B-7). Arkansas, Illinois, and Wisconsin were the only banding States from which both adults and immatures were recovered directly in Missouri. Besides Missouri, Kentucky contributed most to the Missouri dove harvest, providing 2% of the harvest, based on weighted data.

Table 10. *Direct recovery rates (%) by banding region for mourning doves banded in Missouri in 1968–76.*[a]

	Missouri Banding Region			
Age and sex	Eastern	Central	Western	Total
Immatures	3.80	3.51	2.05	3.30
Adults				
Males	3.12	2.45	2.20	2.56
Females	3.11	1.94	1.85	2.33
Total	3.12	2.25	1.98	2.47
Grand total	3.59	3.11	2.01	3.02

[a]For direct recovery rates by age, sex, and year of banding, see Appendix Table B-8.

Direct Recovery Rates

The average direct recovery rate for mourning doves of all ages was 3.02% (Table 10). Recovery rates by age and sex varied according to year of banding. The average annual direct recovery rate of immature mourning doves (3.30%) was significantly higher than the average annual direct recovery rate of adult doves (2.47%). The average direct recovery rates of adult males and adult females were 2.56

Table 11. *Survival rates (%) of adult mourning doves banded in Missouri in 1968–76.*

Year banded	Number banded	Year of recovery 1968	1969	1970	1971	1972	1973	1974	1975	1976	Total
1968	687	13	9	6	2	1	1	1	–	–	33
1969	1,508		41	12	7	4	1	–	1	–	66
1970	842			24	7	8	2	1	–	–	42
1971	1,083				21	8	5	1	–	–	35
1972	1,359					34	6	5	1	–	46
1973	904						23	5	5	2	35
1974	456							13	1	1	15
1975	227								5	2	7
1976	261									7	7
Total	7,327	13	50	42	37	55	38	26	13	12	

Results:

Year	Survival rate	Standard error	95% confidence interval
1968	64.60	16.19	32.87– 96.34
1969	34.34	7.80	19.04– 49.64
1970	71.97	17.86	36.96–106.98
1971	46.76	11.30	24.60– 68.91
1972	28.36	7.22	14.22– 42.51
1973	44.70	15.09	15.12– 74.27
1974	25.45	12.78	4.21– 50.83
1975	23.31	14.04	−4.21– 50.83

Average survival rate = 42.4%
Standard error = 3.1
95% confidence interval = 36.4–48.5
Mortality rate = 57.6%

and 2.33%, respectively. The average annual direct recovery rate for the three Missouri regions was variable. The western region had the lowest rate (2.01%); eastern and central Missouri had rates of 3.59 and 3.11%, respectively. Eastern Missouri had the highest direct recovery rate for all ages and sexes, and central Missouri was next.

Survival Rates

An average annual adult survival rate of 42% was computed for Missouri for 1968–76 (Table 11). The annual survival rates for adult males and adult females during this period were 47 and 31%, respectively (Tables 12 and 13).

Table 12. *Survival rates (%) of adult male mourning doves banded in Missouri in 1968–76.*

Year banded	Number banded	Year of recovery 1968	1969	1970	1971	1972	1973	1974	1975	1976	Total
1968	456	11	8	4	2	1	1	1	–	–	28
1969	805		20	9	5	3	1	–	–	–	38
1970	618			18	4	8	2	1	–	–	33
1971	730				13	6	4	1	–	–	24
1972	526					20	5	5	1	–	31
1973	526						19	3	5	1	28
1974	266							8	1	–	9
1975	138								2	–	2
1976	174									5	5
Total	4,537	11	28	31	24	38	32	19	9	6	

Results:

Survival rate = 46.7%
Standard error = 3.0
95% confidence interval = 40.8–52.7
Mortality rate = 53.3%

Table 13. *Survival rates (%) of adult female mourning doves banded in Missouri in 1968–76.*

Year banded	Number banded	Year of recovery									Total
		1968	1969	1970	1971	1972	1973	1974	1975	1976	
1968	231	2	1	2	–	–	–	–	–	–	5
1969	703		21	3	2	1	–	–	1	–	28
1970	224			6	3	–	–	–	–	–	9
1971	353				8	2	1	–	–	–	11
1972	535					14	1	–	–	–	15
1973	378						4	2	–	1	7
1974	190							5	–	1	6
1975	89								3	2	5
1976	87									2	2
Total	2,790	2	22	11	13	17	6	7	4	6	

Results:

Survival rate = 31.2%
Standard error = 4.7
95% confidence interval = 22.0–40.4
Mortality rate = 68.8%

The immature survival rate for this period was 25% (Table 14).

Hunting Mortality

For adult doves, mortality attributable to hunting was computed as 18% of total mortality; for immatures, the figure was 19% (Table 15). Hunting caused about 20% of adult male mortality and 14% of adult female mortality ($P < 0.05$).

Productivity Needed to Maintain a Stable Population

Productivity required to maintain a stable population was estimated by using the survival rates from Tables 11 and 14. Considering the entire period, 2.3 young produced per adult were required to maintain a stable population (Table 16).

Table 14. *Survival rates of immature mourning doves banded in Missouri in 1968–76.*

Year banded	Number banded	Year of recovery									Total
		1968	1969	1970	1971	1972	1973	1974	1975	1976	
1968	1,266	45	12	2	–	2	–	1	–	–	62
1969	1,063		53	6	6	–	–	1	–	–	66
1970	1,945			59	8	9	3	1	–	–	80
1971	2,299				87	16	6	2	2	–	113
1972	2,676					72	12	3	1	3	91
1973	861						24	5	2	–	31
1974	1,606							55	15	1	71
1975	1,502								46	11	57
1976	1,078									31	31
Total	14,296	45	65	67	101	99	45	68	66	46	

Results:

Year	Survival rate	Standard error	95% confidence interval
1968	29.80	8.01	14.09–45.45
1969	23.95	7.52	9.21–38.70
1970	32.51	8.89	15.09–49.93
1971	32.72	7.95	17.14–48.31
1972	17.85	5.04	7.97–27.73
1973	17.69	9.16	-0.26–35.65
1974	28.39	12.71	3.49–53.30
1975	17.44	8.95	-0.10–34.99

Average survival rate = 25.1%
Standard error = 3.1
95% confidence interval = 19.0–31.1
Mortality rate = 74.9%

Table 15. *Mortality attributable to hunting for mourning doves banded in Missouri 1968–76 and recovered through 1976.*

Statistic	Males	Females	Adults	Immatures
Direct recovery rate[a]	0.026	0.023	0.025	0.033
Harvest rate[b]	0.080	0.073	0.077	0.103
Kill rate[c]	0.108	0.099	0.104	0.139
Mortality rate[d]	0.533	0.688	0.576	0.750
Mortality due to hunting[e]	0.203	0.143	0.181	0.186

[a]First year after banding – from Table B-8.

[b]Harvest rate = recovery rate/reporting rate.

[c]Kill rate = harvest rate/(1 – crippling rate).

[d]Average mortality rate from Tables 11–14.

[e]Kill rate/mortality rate.

Table 16. *Estimated mourning dove productivity required to maintain a stable population (immatures per adult).*

Year	Mortality of adults	Survival of immatures	Productivity required
1969	65.66	23.95	2.74
1970	28.03	32.51	0.86
1971	53.24	32.72	1.63
1973	55.30	17.69	3.13
1974	74.55	28.39	2.63
1975	76.69	17.44	4.40
Average	57.6	25.1	2.3

Discussion

Geographic Dispersal of Doves Banded in Missouri

Mourning doves banded in Missouri were recovered primarily in the Central and Eastern Management Units but some doves moved into Mexico and Central America. Two doves were recovered in California (Western Management Unit), but this may represent wandering of immatures, since both doves were immatures at the time of banding in Missouri.

Although there were exceptions, mourning doves were harvested along two main pathways. Doves from eastern Missouri generally moved south-southeast into Mississippi, Louisiana, Alabama, Georgia, South Carolina, and Florida. Some central Missouri doves also migrated to the southeast. Most doves from the central and western regions of Missouri migrated across Kansas and Oklahoma into Texas, Louisiana, Mexico, and Central America. Wight (1954) demonstrated that many doves banded in Missouri migrated into Texas and Mexico. However, our study shows that the migration route of doves banded in eastern Missouri is similar to that of doves banded in States bordering Missouri on the east, and the movement is primarily southeastward. The importance of Missouri doves to the harvest in Florida is shown by Marion et al. (1981). During 1931–78, 11.4% of the weighted direct recoveries of doves banded elsewhere and recovered in Florida were doves banded in Missouri.

About 76% of the direct recoveries of doves of all ages banded in Missouri 1968–76 were made in Missouri. The percentage of adults recovered in Missouri was significantly higher than immatures: 86 vs. 72%. The lower percentage of immatures may be due to their leaving the State before or shortly after the opening of dove season on September 1. The early movement of immature doves has been reported in Illinois (Hanson and Kossack 1963), Louisiana (Watts 1969), and Tennessee (Orr 1973). Tomlinson et al. (1960) found that immature doves in Missouri left the natal area soon after banding. It was not determined whether these doves left the State or merely left the area of banding. Dunks (1977) reported that immature doves in Texas were more likely to migrate outside their breeding area than adults.

A higher percentage of total recoveries of adult males than adult females was made in Missouri: 93 vs. 72%. This finding is also supported by earlier studies. Harris (1961*b*) reported more males than females in a 141-bird sample of southwest Missouri doves taken by hunting between 1 September and 6 October 1956. He attributed this to more males in the population or their greater vulnerability to hunting. Chambers et al. (1962) found wintering flocks of doves near the Fountain Grove Wildlife Area in northwest Missouri composed mostly of adult males, and offered evidence that male doves tend to winter farther north than females. Henry (1970), also working in Missouri, reported that the percentage of males recovered in Missouri was higher than females. He believed this to be the result of females being more migratory than males. In the present study there was some evidence that females may migrate much farther south than males. Four recoveries of females were made in Central America. No males were recovered this far south.

For some reason, doves (both adults and immatures) banded in both the eastern and central regions of Missouri had appreciably higher in-state recovery rates than did those banded in western Missouri. Utilizing another data set, Henry (1970) found a higher rate of in-state recoveries for doves banded near Columbia, Missouri (central region), than those banded at the Fountain Grove Wildlife Area (western region). He suggested that this difference might be due to heavier hunting pressure and higher band-reporting rates at Columbia. These explanations seem questionable from our data, which were based on several banding locations in each Missouri region, but we can offer no alternative suggestions.

For adult females and immatures, the percentages of indirect in-state recoveries were similar. For adult males, however, they differed significantly; only 78% of adult male indirect recoveries were made in State compared with

93% in-state direct recoveries. Migrational homing to nesting sites has been demonstrated by Tomlinson et al. (1960) and Harris (1961*a*). Because males so readily return to the area of previous nesting, the difference in direct and indirect in-state recoveries of adult males is probably not due to doves failing to return to the State, but due to reduced mortality for the segment of the male population that did migrate.

Chronology of the Harvest of Doves Banded in Missouri

Recovery data indicate that about 60% of the harvest of Missouri-banded doves occurs during the first 10 days of September and over 95% of the adult and 93% of the immature harvest occurs during September and October. More than 88% of Missouri-banded adult males were harvested during September; female harvest during September was less than 78% of total harvest. About 99% of the harvest of adult males occurred during September–October; adult female harvest during that period was less than 89%. Lewis and Morrison (1978) estimated 61% of the dove harvest in Oklahoma occurred in the first week of September and Orr (1973) found more doves harvested in Louisiana during September than during later portions of the hunting season. Thus, our findings are similar to those of other comparable studies.

Marion et al. (1981) found that the percentage of immigrant doves in Florida's harvest increased during the second 10-day period of open season (October 11–21), then stabilized at about 66% until the season ended on January 31.

States Contributing to the Missouri Dove Harvest

Direct recoveries of mourning doves banded elsewhere and recovered in Missouri were from States in the Eastern and Central Management Units. States contributing to the Missouri dove harvest were primarily those that border Missouri (Arkansas, Illinois, Iowa, Kansas, and Kentucky). Mississippi, North Dakota, and Wisconsin were the only States not bordering Missouri that had banded doves recovered in Missouri. More than 70% of the recoveries of doves banded out of State and recovered in Missouri were recovered in the eastern region of the State.

Most recoveries in Missouri of doves banded outside the State occurred during September. Of these, the number of recoveries of immatures decreased sharply after the first 10 days in September; recoveries of adult doves were more evenly distributed through September and October. This suggests immatures had moved out of Missouri by mid-September.

Doves banded out of State made up less than 7% of the banded doves recovered in Missouri. Adult doves from other States contributed slightly over 5% of the banded adults harvested in Missouri and nearly 8% of the Missouri harvest of banded immatures consisted of doves from other States. More doves from other States were harvested in eastern Missouri than in any other region; there, 28% of the immature harvest and 8% of the adult harvest consisted of doves from other States.

Direct Recovery Rates

Recovery rates for immatures were significantly higher than for adults; immatures were 1.3 times more vulnerable to hunters than were adults. The direct recovery rate for mourning doves of all ages banded in western Missouri was significantly lower than the direct recovery rates for central and eastern Missouri. The latter finding agrees with the findings of Henry (1970) that mourning doves banded in western Missouri have lower direct recovery rates than doves banded elsewhere in the State.

Orr (1973) reported that direct recovery rates of adult female doves in Tennessee were higher than those for males, and Watts (1969) also found the direct recovery rates for female mourning doves in Louisiana higher than those of adult males. Our findings in Missouri differed from these; direct recovery rates for adult males (2.6%) did not differ significantly from those for adult females (2.3%).

Survival Rates

Survival rates for adults (42%) and immatures (25%) computed in our study generally agree with the findings of other studies (Table 17). However, there are some differences. Estimated adult and immature survival rates of doves in Tennessee were similar (Orr 1973) but both were lower than those computed for Missouri. Dunks (1977) computed adult survival rates in Texas similar to those in Missouri, but his estimate of immature survival rate was considerably higher. In all studies reported in Table 17, immatures had lower survival rates than adults.

Dunks et al. (1982) found that survival rates for doves banded in different States in the Central Management Unit were variable. The differences in survival rates of doves computed in our study from those for other studies seem sufficient to prevent applying survival estimates computed for Missouri to other States.

The survival rate of adult male doves banded during our study was significantly higher than the female survival rate: 47 vs. 31%, respectively. Higher survival rates of males were also reported from Louisiana (Orr 1973) and for the Eastern Management Unit (Hayne 1975). Assuming a 1:1 tertiary sex ratio, there is a potential for a surplus of males in the population. Differential survival rates and wintering habits of the two sexes could lead to drastic fluctuations in sex ratios. If sex ratios fluctuate drastically, that could affect the interpretation (or validity) of call-count data, because unmated male doves coo at much higher rates than mated ones (Baskett et al. 1978).

Table 17. *Estimated survival rates of mourning doves according to location of study and method of computing survival rates.*

Location	Survival rate (%)		Method of computation[a]	Source
	Adult	Immature		
Missouri	45.0	26.0	LT	Tomlinson (1959)
Louisiana	37.0	18.0	LT	Watts (1969)
Missouri	53.4	35.3	RRR	Reeves (unpubl. rep.)
Missouri	52.9	34.3	LT	Henry (1970)
Tennessee	19.2	16.7	SM	Orr (1973)
Eastern United States[b]	39.1	25.8	SM	Hayne (1975)
Texas	44.8	41.4	SM	Dunks (1977)
Missouri	42.4	25.1	SM	Present study
Oklahoma	52.4[c]		SM	Lewis and Morrison (1978)
Missouri	44.1	26.1	SM	Dunks et al. (1982)

[a] LT = Life table; RRR = Relative recovery rate; SM = Stochastic model.

[b] Eastern Management Unit (see Fig. 1).

[c] Adults and immatures combined.

Mortality Attributable to Hunting

The proportions of mortality due to hunting were similar for immature and adult doves: 19 and 18%, respectively. However, immature survival rates were much lower than adult survival rates. Therefore, the non-hunting mortality of immatures was greater than the non-hunting mortality of adults. A similar relationship was found by other workers (Dunks 1977; H. M. Reeves, upubl. rep.).

Although adult males experienced a higher proportion of mortality from hunting than did females (20 vs. 14%, respectively), survival rates of adult females were considerably less than survival rates of adult males. Therefore, females had a higher non-hunting mortality rate.

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Appendix A

Geographic Distribution of Band Recoveries for Mourning Doves Banded in Missouri, 1968–76

Figs. A-1 through A-4 are maps depicting band recovery locations by 1° latitude and longitude blocks for mourning doves banded in Missouri and recovered elsewhere.

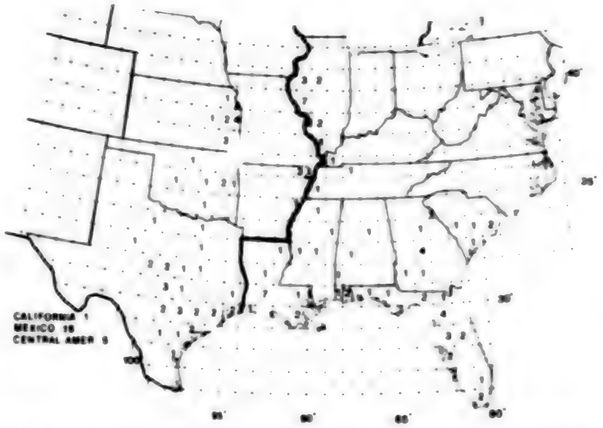

Fig. A-1. Geographic distribution of direct recoveries of mourning doves of all ages banded in Missouri 1968–76 and recovered outside Missouri through 1976.

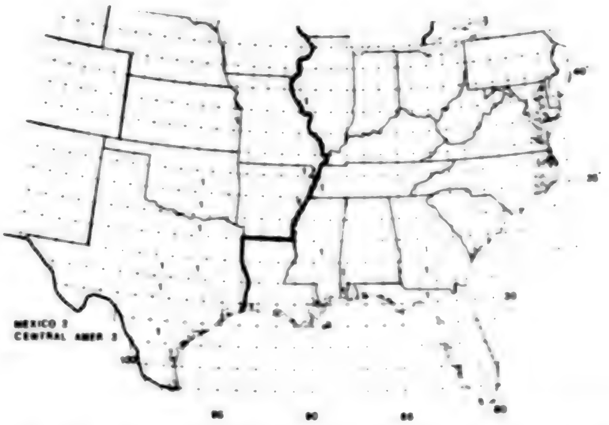

Fig. A-2. Geographic distribution of direct recoveries of adult mourning doves banded in Missouri 1968–76 and recovered outside Missouri through 1976.

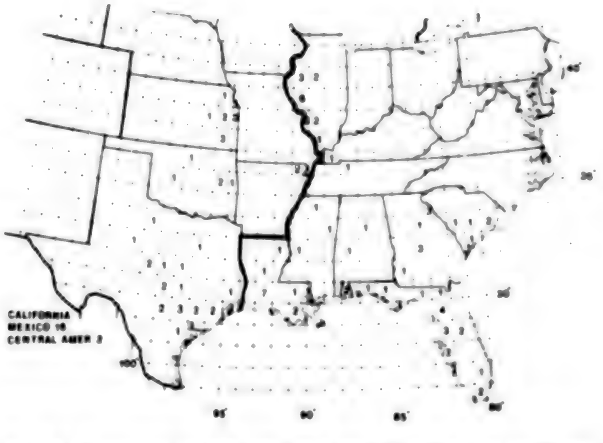

Fig. A-3. Geographic distribution of direct recoveries of immature mourning doves banded in Missouri 1968–76 and recovered outside Missouri through 1976.

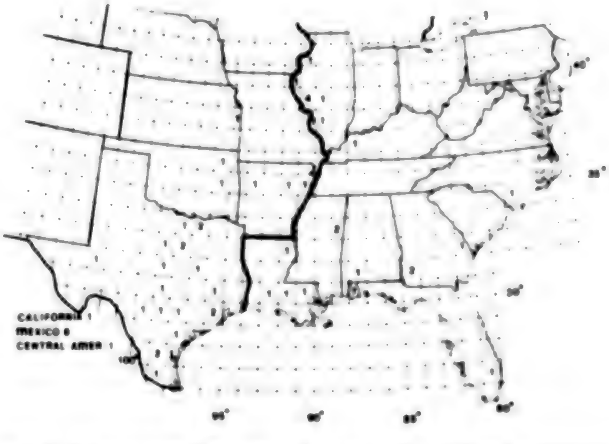

Fig. A-4. Geographic distribution of indirect recoveries of mourning doves of all ages banded in Missouri 1968–76 and recovered outside Missouri through 1976.

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Appendix B

Detailed Tabular Data about Band Recoveries for Doves Banded in Missouri, 1968–76

Tables B-1 through B-5 include data about chronology and geographic distribution of band recoveries. Tables B-6 through B-8 contain miscellaneous information about band recoveries.

Table B-1. *Geographic distribution of indirect recoveries of mourning doves banded in Missouri in 1968–76 and recovered through 1976.*

Area of recovery	Life stage and Missouri banding region																Grand total
	Adult												Immature				
	Eastern			Central			Western			Total							
	A[a]	M	F	A	M	F	A	M	F	A	M	F	Eastern	Central	Western	Total	
Missouri																	
Eastern	39	31	8	1	1	–	–	–	–	40	32	8	41	1	–	42	82
Central	–	–	–	23	18	5	1	–	1	24	18	6	1	34	–	35	59
Western	–	–	–	2	2	–	18	15	3	20	17	3	–	2	12	14	34
Total	39	31	8	26	21	5	19	15	4	84	67	17	42	37	12	91	175
Alabama	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	2	2
Arkansas	1	–	1	–	–	–	–	–	–	1	–	1	2	–	–	2	3
California	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	1
El Salvador	–	–	–	–	–	–	1	–	1	1	–	1	–	–	–	–	1
Florida	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	1	1
Georgia	–	–	–	–	–	–	–	–	–	–	–	–	2	1	–	3	3
Illinois	1	1	–	1	1	–	–	–	–	2	2	–	3	3	1	7	9
Kansas	–	–	–	–	–	–	1	1	–	1	1	–	–	1	–	1	2
Kentucky	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	1
Louisiana	1	–	1	–	–	–	–	–	–	1	–	1	–	3	–	3	4
Mexico	–	–	–	2	2	–	2	1	1	4	3	1	–	1	2	3	7
Mississippi	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	2	2
N. Carolina	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	1
Oklahoma	–	–	–	1	1	–	1	–	1	2	1	1	–	–	–	–	2
Texas	2	2	–	3	2	1	4	4	–	9	8	1	1	5	6	12	21
Total	44	34	10	33	27	6	28	21	7	105	82	23	53	55	22	130	235

[a] A = total adults, M = males, F = females.

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Table B-2. *Chronology of direct recoveries of adult mourning doves banded in Missouri 1968–76 and recovered through 1976.*

	Date of recovery								
	September								
Recovery location	1–10	11–20	21–30	Total	Oct.	Nov.	Dec.	Jan.	Feb.
Missouri									
Eastern	47	8	3	58	9	–	–	–	–
Central	27	12	3	42	2	–	–	–	–
Western	26	8	1	35	1	–	–	–	–
Total	100	28	7	135	12	–	–	–	–
Eastern Management Unit									
Alabama	–	–	–	–	–	1	1	–	–
Florida	–	–	–	–	–	–	–	1	–
Georgia	–	–	1	1	–	–	–	1	–
Illinois	–	–	1	1	–	–	–	–	–
Louisiana	–	–	–	–	1	–	–	–	–
Mississippi	–	–	–	–	–	1	–	–	–
Tennessee	–	–	–	–	1	–	–	–	–
Total	–	–	2	2	2	2	1	2	–
Central Management Unit									
Arkansas	–	1	–	1	–	–	–	–	–
Kansas	2	–	–	2	–	–	–	–	–
Oklahoma	–	–	–	–	2	–	–	–	–
Texas	–	4	1	5	1	–	–	–	–
Total	2	5	1	8	3	–	–	–	–
Mexico–Central America									
Mexico	–	–	–	–	1	–	–	–	1
Central America	–	–	–	–	1	–	1	1	–
Total	–	–	–	–	2	–	1	1	1
Grand total	102	33	10	145	19	2	2	3	1

Table B-3. *Chronology of direct recoveries of immature mourning doves banded in Missouri in 1968–76 and recovered through 1976.*

	Date of recovery								
	September								
Recovery location	1–10	11–20	21–30	Total	Oct.	Nov.	Dec.	Jan.	Feb.
Missouri									
Eastern	116	33	6	155	11	–	–	–	–
Central	92	14	8	114	6	–	–	–	–
Western	28	5	–	33	–	–	–	–	–
Total	236	52	14	302	17	–	–	–	–
Eastern Management Unit									
Alabama	–	–	2	2	1	1	–	–	–
Florida	–	–	–	–	12	4	3	1	–
Georgia	2	1	–	3	1	1	1	–	–
Illinois	11	4	1	16	–	–	–	–	–
Kentucky	–	2	–	2	–	–	–	–	–
Louisiana	1	–	–	1	3	3	3	2	–
Mississippi	–	–	1	1	–	2	–	1	–
South Carolina	–	2	–	2	1	–	1	–	–
Tennessee	–	–	–	–	1	–	–	–	–
Total	14	9	4	27	19	11	8	4	–
Central Management Unit									
Arkansas	1	1	–	2	–	–	–	–	–
Kansas	5	4	–	9	1	–	–	–	–
Oklahoma	3	1	1	5	–	–	–	–	–
Texas	2	3	2	7	14	2	–	1	–
Total	11	9	3	23	15	2	–	1	–
Western Management Unit									
California	1	–	–	1	–	–	–	–	–
Mexico–Central America									
Mexico	–	–	–	–	4	3	1	1	1
Central America	–	–	–	–	–	1	1	–	–
Total	1	–	–	1	4	4	2	1	1
Grand total	262	70	21	353	55	17	10	6	1

Table B-4. *Chronology of direct recoveries of adult male mourning doves banded in Missouri in 1968–76 and recovered through 1976.*

	Date of recovery								
	September								
Recovery location	1–10	11–20	21–30	Total	Oct.	Nov.	Dec.	Jan.	Feb.
Missouri									
Eastern	29	5	3	37	8	–	–	–	–
Central	17	10	3	30	1	–	–	–	–
Western	20	4	1	25	–	–	–	–	–
Total	66	19	7	92	9	–	–	–	–
Eastern Management Unit									
Georgia	–	–	1	1	–	–	–	–	–
Central Management Unit									
Kansas	1	–	–	1	–	–	–	–	–
Oklahoma	–	–	–	–	1	–	–	–	–
Texas	–	2	–	2	1	–	–	–	–
Total	1	2	–	3	2	–	–	–	–
Mexico-Central America									
Mexico	–	–	–	–	1	–	–	–	1
Grand total	67	21	8	96	12	–	–	–	1

Table B-5. *Chronology of direct recoveries of adult female mourning doves banded in Missouri in 1968–76 and recovered through 1976.*

	Date of recovery								
	September								
Recovery location	1–10	11–20	21–30	Total	Oct.	Nov.	Dec.	Jan.	Feb.
Missouri									
Eastern	17	3	–	20	1	–	–	–	–
Central	10	2	–	12	1	–	–	–	–
Western	6	4	–	10	1	–	–	–	–
Total	33	9	–	42	3	–	–	–	–
Eastern Management Unit									
Alabama	–	–	–	–	–	1	1	–	–
Florida	–	–	–	–	–	–	–	1	–
Georgia	–	–	–	–	–	–	–	1	–
Illinois	–	–	1	1	–	–	–	–	–
Louisiana	–	–	–	–	1	–		–	–
Mississippi	–	–	–	–	–	1	–	–	–
Tennessee	–	–	–	–	1	–	–	–	–
Total	–	–	1	1	2	2	1	2	–
Central Management Unit									
Arkansas	–	1	–	1	–	–	–	–	–
Kansas	1	–	–	1	–	–	–	–	–
Oklahoma	–	–	–	–	1	–	–	–	–
Texas	–	2	1	3	–	–	–	–	–
Total	1	3	1	5	1	–	–	–	–
Central America	–	–	–	–	1	–	1	1	–
Grand total	34	12	2	48	7	2	2	3	–

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Table B-6. *Weighting factors for mourning doves banded outside Missouri in 1968–76 and recovered in Missouri through 1976.*

State contributing to harvest	Land area weight	x̄ number doves per route	Number doves banded		Weighting factor	
			Adult	Immature	Adult	Immature
Arkansas	34.37	22.79	4,270	7,155	0.18	0.11
Illinois	35.09	26.63	5,293	7,556	0.18	0.12
Iowa	36.15	39.33	10,963	9,244	0.10	0.12
Kansas	52.43	57.06	12,085	8,452	0.25	0.35
Kentucky	26.08	25.84	1,604	4,432	0.42	0.15
Mississippi	30.63	24.23	5,079	13,710	0.15	0.05
North Dakota	45.54	29.01	4,836	9,438	0.27	0.14
Wisconsin	36.07	11.34	3,654	8,903	0.11	0.05
Missouri[a]	45.10	31.33	7,327	14,297	0.19	0.10

[a] Values shown are weighting factors for Missouri used in estimating contribution to Missouri harvest by other States.

Table B-7. *Contribution to harvest of weighted direct recoveries of adult and immature mourning doves banded in 1968–76 and recovered in Missouri through 1976.*

Life stage and State of origin	Weighting factor	Direct recoveries		
		Number	Weighted	Contribution to harvest
Adults				
Missouri	0.19	155	29.5	94.7
Arkansas	0.18	1	0.2	0.6
Illinois	0.18	2	0.4	1.2
Iowa	0.10	1	0.1	0.3
Kansas	0.25	1	0.3	0.8
North Dakota	0.27	2	0.5	1.7
Wisconsin	0.11	2	0.2	0.7
Total			31.2	100.0
Immatures				
Missouri	0.10	340	34.0	92.4
Arkansas	0.11	4	0.4	1.2
Illinois	0.12	6	0.7	2.0
Kentucky	0.15	9	1.4	3.7
Mississippi	0.05	2	0.1	0.3
Wisconsin	0.05	4	0.2	0.5
Total			36.8	100.0

Table B-8. *Annual direct recovery rates (%) for mourning doves banded in Missouri in 1968–76 and recovered through 1976.*

Year banded	Adults			Immatures	Total
	Males	Females	Total		
1968	2.41	0.87	1.89	3.55	2.97
1969	2.48	2.99	2.72	4.98	3.65
1970	2.91	2.68	2.85	3.03	2.98
1971	1.78	2.27	1.94	3.78	3.19
1972	2.43	2.62	2.50	2.69	2.63
1973	3.61	1.06	2.54	2.79	2.66
1974	3.01	2.63	2.85	3.42	3.30
1975	1.45	3.37	2.20	3.06	2.95
1976	2.87	2.30	2.68	2.88	2.84
Total	2.56	2.33	2.47	3.30	3.02

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